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Naval Oceanographic and
Atmospheric Research Laboratory

Technical Note 134
August 1991

SEVERE WEATHER GUIDE MEDITERRANEAN PORTS

44. SOUDA BAY

Atmospheric Research Laboratory,

Stennis

ABSTRACT

This handbook for the port of Souda Bay, one in a series of severe weather guides for Mediterranean ports, provides decision-making guidance for ship captains whose vessels are threatened by actual or forecast strong winds, high seas, restricted visibility or thunderstorms in the port vicinity. Causes and effects of such hazardous conditions are discussed. Precautionary or evasive actions are suggested for various vessel situations. The handbook is organized in four sections for ready reference: general guidance on handbook content and use; a quick-look captain's summary; a more detailed review of general information on environmental conditions; and an appendix that provides oceanographic information.

ACKNOWLEDGMENTS

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FOREWORD

This handbook on Mediterranean Ports was developed as part of an ongoing effort at the Atmospheric Directorate, Naval Oceanographic and Atmospheric Laboratory (NOARL), Monterey, to create products for direct application to Fleet Operations. The research was conducted in response to Commander Naval Oceanography Command (COMNAVOCEANCOM) requirements validated by the Chief of Naval Operations (OP-096).

As mentioned in the preface, the Mediterranean region is unique in that several areas exist where local winds can cause dangerous operating conditions. This handbook will provide the ship's captain with assistance in making decisions regarding the disposition of his ship when heavy winds and seas are encountered or forecast at various port locations.

Readers are urged to submit comments, suggestions for changes, deletions and/or additions to Naval Oceanography Command Center (NAVOCEANCOMCEN), Rota with a copy to the oceanographer, COMSIXTHFLT. They will then be passed on to NOARL, Monterey for review and incorporation as appropriate. This document will be a dynamic one, changing and improving as more and better information is obtained.

PORT INDEX

The following is a tentative prioritized list of Mediterranean Ports to be evaluated during the five-year period 1988-92, with ports grouped by expected year of the port study's publication. This list is subject to change as dictated by circumstances and periodic review. Computerized versions of these port guides are available for those ports with an asterisk (*). Contact the Atmospheric Directorate, NOARL, Monterey or NOCC Rota for IBM compatable floppy disk copies.

NO.	PORT
*1	GAETA, ITALY
*2	NAPLES, ITALY
*3	CATANIA, ITALY
*4	AUGUSTA BAY, ITALY
*5	CAGLIARI, ITALY
*6	LA MADDALENA, ITALY
7	MARSEILLE, FRANCE
8	TOULON, FRANCE
9	VILLEFRANCHE, FRANCE
10	MALAGA, SPAIN
11	NICE, FRANCE
12	CANNES, FRANCE
13	MONAÇO
14	ASHDOD, ISRAEL
15	HAIFA, ISRAEL
16	BARCELONA, SPAIN
17	PALMA, SPAIN
18	IBIZA, SPAIN
19	POLLENSA BAY, SPAIN
20	LIVORNO, ITALY
21	LA SPEZIA, ITALY
22	VENICE, ITALY
23	TRIESTE, ITALY
*24	CARTAGENA, SPAIN
*25	VALENCIA, SPAIN
*26	SAN REMO, ITALY
*27	GENOA, ITALY
*28	PORTO TORRES, ITALY
*29	PALERMO, ITALY
*30	MESSINA, ITALY
*31	TAORMINA, ITALY

1991	PORT
*32	TARANTO, ITALY
*33	TANGIER, MOROCCO
*34	BENIDORM, SPAIN
*35	ROTA, SPAIN
*36	LIMASSOL, CYPRUS
*37	LARNACA, CYPRUS
*38	ALEXANDRIA, EGYPT
*39	PORT SAID, EGYPT
*40	BIZERTE, TUNISIA
*41	TUNIS, TUNISIA
*42	SOUSSE, TUNISIA
*43	SFAX, TUNISIA
*44	SOUDA BAY, CRETE
	VALETTA, MALTA
	PIRAEUS, GREECE

1992	PORT
	KALAMATA, GREECE
	CORFU, GREECE
	KITHIRA, GREECE
	THESSALONIKI, GREECE

DELAYED INDEFINITELY
ALGIERS, ALGERIA
ISKENDERUN, TURKEY
IZMIR, TURKEY
ISTANBUL, TURKEY
ANTALYA, TURKEY
GOLCUK, TURKEY

PREFACE

Environmental phenomena such as strong winds, high waves, restrictions to visibility and thunderstorms can be hazardous to critical Fleet operations. The cause and effect of several of these phenomena are unique to the Mediterranean region and some prior knowledge of their characteristics would be helpful to ship's captains. The intent of this publication is to provide guidance to the captains for assistance in decision making.

The Mediterranean Sea region is an area where complicated topographical features influence weather patterns. Katabatic winds will flow through restricted mountain gaps or valleys and, as a result of the venturi effect, strengthen to storm intensity in a short period of time. As these winds exit and flow over port regions and coastal areas, anchored ships with large 'sail areas' may be blown aground. Also, hazardous sea state conditions are created, posing a danger for small boats ferrying personnel to and from port. At the same time, adjacent areas may be relatively calm. A glance at current weather charts may not always reveal the causes for these local effects which vary drastically from point to point.

Because of the irregular coast line and numerous islands in the Mediterranean, swell can be refracted around such barriers and come from directions which vary greatly with the wind. Anchored ships may experience winds and seas from one direction and swell from a different direction. These conditions can be extremely hazardous for tendered vessels. Moderate to heavy swell may also propagate outward in advance of a storm resulting in uncomfortable and sometimes dangerous conditions, especially during tending, refueling and boating operations.

This handbook addresses the various weather conditions, their local cause and effect and suggests some evasive action to be taken if necessary. Most of the major ports in the Mediterranean will be covered in the handbook. A priority list, established by the Sixth Fleet, exists for the port studies conducted and this list will be followed as closely as possible in terms of scheduling publications.

RECORD OF CHANGES

CHANGE NUMBER	DATE OF CHANGE	DATE ENTERED	PAGE NUMBER	ENTERED BY

1. GENERAL GUIDANCE

1.1 DESIGN

This handbook is designed to provide ship captains with a ready reference on hazardous weather and wave conditions in selected Mediterranean harbors. Section 2, the captain's summary, is an abbreviated version of section 3, the general information section intended for staff planners and meteorologists. Once section 3 has been read, it is not necessary to read section 2.

1.1.1 Objectives

The basic objective is to provide ship captains with a concise reference of hazards to ship activities that are caused by environmental conditions in various Mediterranean harbors, and to offer suggestions for precautionary and/or evasive actions. A secondary objective is to provide adequate background information on such hazards so that operational forecasters, or other interested parties, can quickly gain the local knowledge that is necessary to ensure high quality forecasts.

1.1.2 Approach

Information on harbor conditions and hazards was accumulated in the following manner:

A. A literature search for reference material was performed.
B. Cruise reports were reviewed.
C. Navy personnel with current or previous area experience were interviewed.
D. A preliminary report was developed which included questions on various local conditions in specific harbors.
E. Port/harbor visits were made by NOARLW personnel; considerable information was obtained through interviews with local pilots, tug masters, etc; and local reference material was obtained.
F. The cumulative information was reviewed, combined, and condensed for harbor studies.

1.1.3 Organization

The Handbook contains two sections for each harbor. The first section summarizes harbor conditions and is intended for use as a quick reference by ship captains, navigators, inport/at sea OOD's, and other interested personnel. This section contains:

A. a brief narrative summary of environmental hazards,
B. a table display of vessel location/situation, potential environmental hazard, effect-precautionary/evasion actions, and advance indicators of potential environmental hazards,
C. local wind wave conditions, and
D. tables depicting the wave conditions resulting from propagation of deep water swell into the harbor.

The swell propagation information includes percent occurrence, average duration, and the period of maximum wave energy within height ranges of greater than 3.3 feet and greater than 6.6 feet. The details on the generation of sea and swell information are provided in Appendix A.

The second section contains additional details and background information on seasonal hazardous conditions. This section is directed to personnel who have a need for additional insights on environmental hazards and related weather events.

1.2 CONTENTS OF SPECIFIC HARBOR STUDIES

This handbook specifically addresses potential wind and wave related hazards to ships operating in various Mediterranean ports utilized by the U.S. Navy. It does not contain general purpose climatology and/or comprehensive forecast rules for weather conditions of a more benign nature.

The contents are intended for use in both pre-visit planning and in situ problem solving by either mariners or environmentalists. Potential hazards related to both weather and waves are addressed. The

oceanographic information includes some rather unique information relating to deep water swell propagating into harbor shallow water areas.

Emphasis is placed on the hazards related to wind, wind waves, and the propagation of deep water swell into the harbor areas. Various vessel locations/situations are considered, including moored, nesting, anchored, arriving/departing, and small boat operations. The potential problems and suggested precautionary/evasive actions for various combinations of environmental threats and vessel location/situation are provided. Local indicators of environmental hazards and possible evasion techniques are summarized for various scenarios.

CAUTIONARY NOTE: In September 1985 Hurricane Gloria raked the Norfolk, VA area while several US Navy ships were anchored on the muddy bottom of Chesapeake Bay. One important fact was revealed during this incident: Most all ships frigate size and larger dragged anchor, some more than others, in winds of over 50 knots. As winds and waves increased, ships 'fell into' the wave troughs, BROADSIDE TO THE WIND and become difficult or impossible to control.

This was a rare instance in which several ships of recent design were exposed to the same storm and much effort was put into the documentation of lessons learned. Chief among these was the suggestion to evade at sea rather than remain anchored at port whenever winds of such intensity were forecast.

2. CAPTAIN'S SUMMARY

The island of Crete is located in the northwest portion of the eastern Mediterranean Sea. Crete forms the southern limit of the Cretan Sea (Figure 2-1).

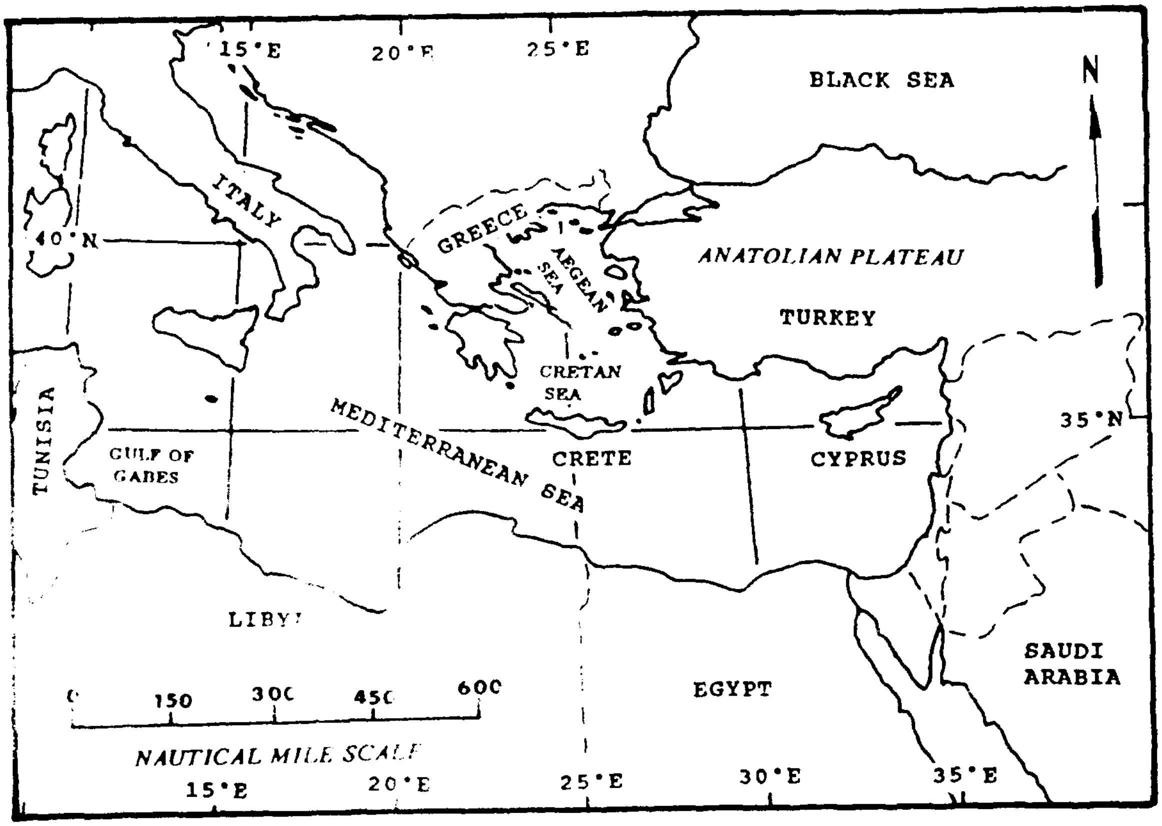

Figure 2-1. Central and Eastern Mediterranean Sea.

Soúda Bay is located on the north coast of Crete at approximately 35°29'N 24°11'E (Figure 2-2). The topography of Crete is rugged and very mountainous, with one peak about 15 n mi south-southeast of the port reaching 8,048 ft (2,453 m). A backbone of mountains exceeding 3,000 ft (914 m) extends east-west the length of the island, with a few north-south valleys cutting deep passages through the mountains.

A low range of mountains, with a mean height of about 1,000 ft (305 m) lies along the north side of the Akrotiri Peninsula. The peninsula is connected to the main island of Crete by a low-lying strip of land which forms a valley west of Soúda Bay.

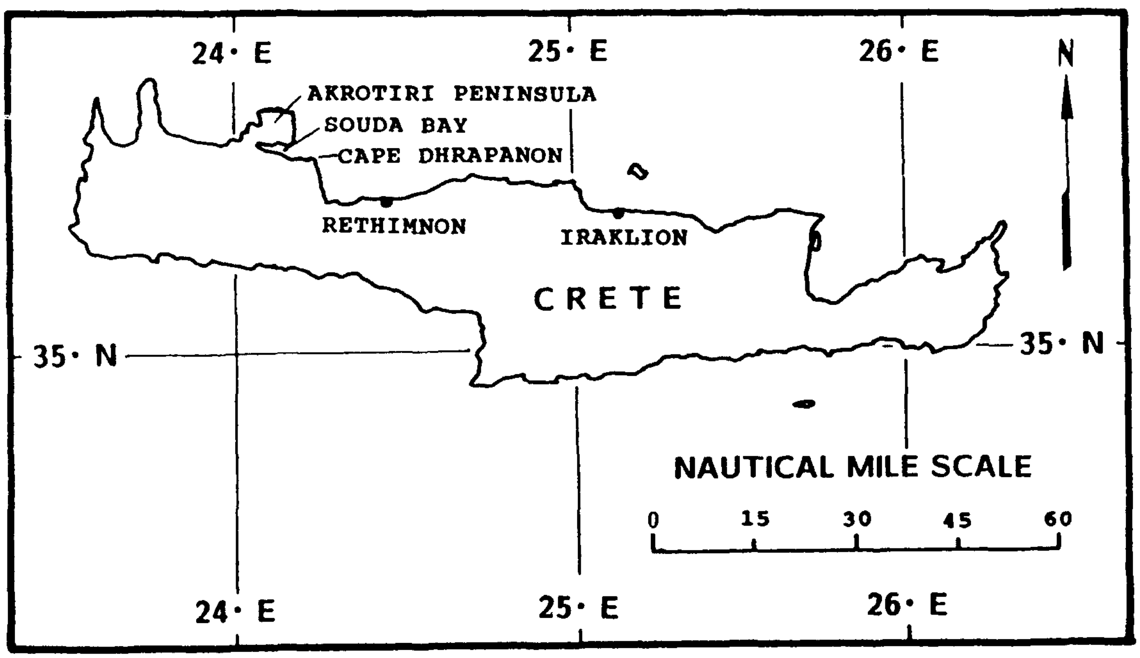

Figure 2-2. Crete

The main facilities of the port lie at the west end of Soúda Bay, just south of the Akrotíri Peninsula (Figure 2-3).

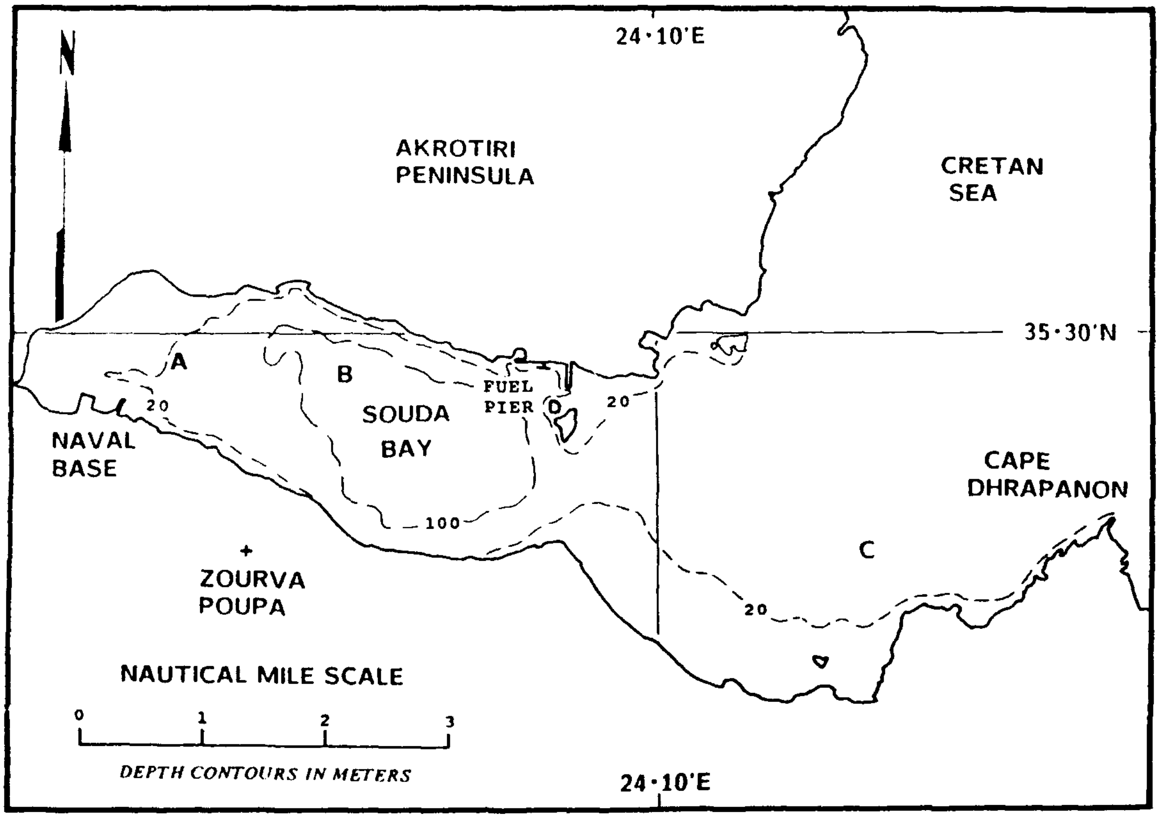

Figure 2-3. Souda Bay, Crete

The pier area at Soúda Bay is primarily a Hellenic Navy Base, but a commercial pier is designated. Specific information regarding lengths of berths in the port is not available. However, only small ships can be accommodated, and alongside depths are limited to 33 ft (10 m). A fleet landing is established at the location specified in Figure 2-4.

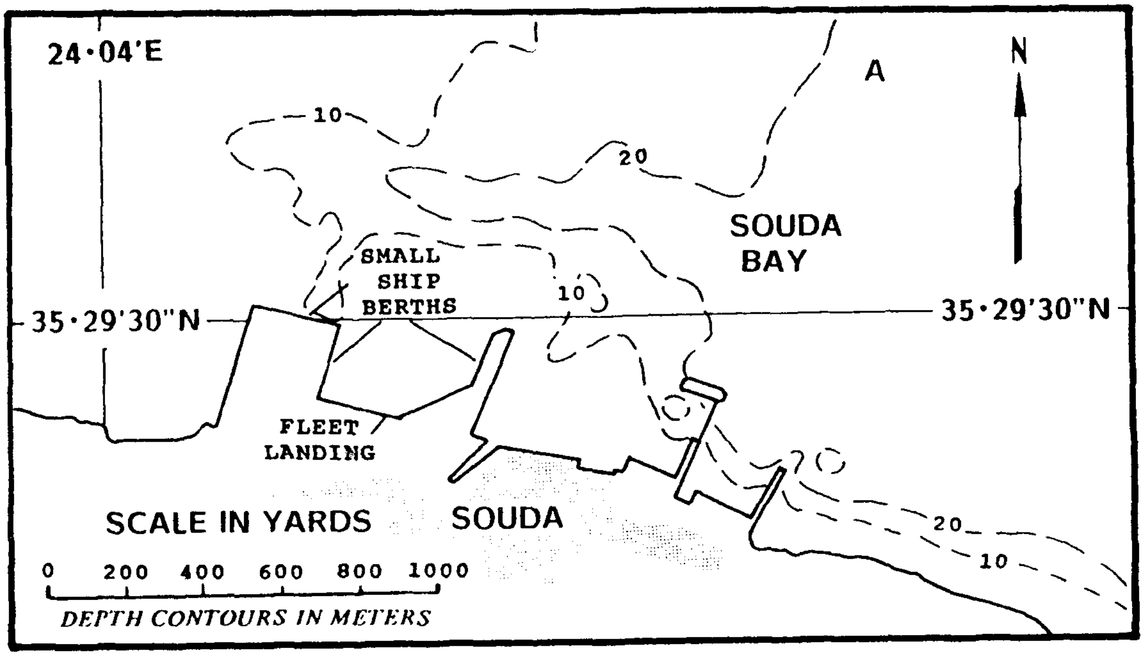

Figure 2-4. Souda Bay Naval Base.

A fuel pier is located on the north side of Soúda Bay approximately 3 1/2 n mi east of the main portion of the port (Figure 2-3). The concrete fuel quay is 450 ft (137 m) long with an axis of 100/280°.

Three anchorages exist at/near Soúda Bay. A small-ship anchorage (mooring buoy array), indicated by the letter "A" on Figures 2-3 and 2-4, is located at the west end of Soúda Bay about 0.3 to 0.8 n mi northeast of the Naval Base. A second anchorage, referred to as the inner bay anchorage and indicated by the letter "B" on Figure 2-3, is located in Soúda Bay approximately 1.9 n mi east of the Naval Base in depths of 390-490 ft (119-149 m). This anchorage may be used by aircraft-carrier sized vessels for liberty visits. The inner bay anchorage bottom is rock and gravel with only fair holding qualities. Anchor dragging is common; ships may have to use engines to maintain position in the anchorage. The fleet landing at the main harbor is used by small boats from ships using the inner bay anchorage.

A third anchorage, referred to as the outer anchorage and indicated by the letter "C" on Figure 2-3 is situated outside Soúda Bay, 6 to 7 n mi east of the main port area. The depth is about 215 ft (66 m). This anchorage is used primarily for limited personnel and supply transfer from the Naval Base. The bottom is flat with rock and gravel. Holding is only fair; anchor dragging may be experienced in strong winds. The fleet landing at the fuel pier is used by small boats from ships using the outer anchorage.

Tides are limited to 2 ft (60 cm), with no unusual tide fluctuations. Currents are negligible, and have no significant effect on navigation.

Specific hazardous conditions, vessel situations, and suggested precautionary/evasive action scenarios are summarized in Table 2-1.

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Table 2-1. Summary of hazardous environmental condition

HAZARDOUS CONDITION	INDICATORS OF POTENTIAL HAZARD	VESSEL LOC SITUATION A
1. SE'ly winds/waves - * Strong events occur 3-4 times per year and last 1-2 days. * Most common during April/May and September/October but may occur anytime during April-October period. * May raise waves to 14 ft (4 m) in outer anchorage. * May raise waves to 7 ft (2 m) in the inner portion of Soúda Bay. * Rain and/ or thunderstorms are possible. * Thunderstorms are most common during October/ November at Souda Bay. * May bring dust if occurring during April-August period.	Advance warning. * An E-W line of altostratus clouds parallel to the coasts W of Cape Dhrápanon and the city of Réthimnon. Considered to be a very reliable indicator by local fishermen. * Reports of strong S'ly winds along the NE coast of Libya is often the precursor of SE'ly scirocco winds over the E Mediterranean. Duration * Strong events last 1 to 2 days.	(1) Moored Base. (2) Moored pier. (3) Anchored ship buc (4) Anchore Bay. (5) Anchore bay.

azardous environmental conditions for the Port of Souda Bay, Greece.

S OF HAZARD	VESSEL LOCATION/ SITUATION AFFECTED	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS
of altostratus lel to the Cape Dhrápanon of Réthimnon. be a very icator by local trong S'ly winds coast of Libya precursor of co winds over rranean. s last 1 to 2	(1) Moored - Naval Base.	(a) Wind reaches Naval Base, but has little effect on moored ships. * Adding or doubling of mooring lines should provide necessary protection against damage. * During spring, a low-level inversion may cause extremely anomalous radar and radio propagation below the inversion. Consequently, helicopters may be out of radio contact at a range of one or two miles.
	(2) Moored - fuel pier.	(a) Wind reaches the fuel pier, but has little effect on moored ships. * Adding or doubling of mooring lines should provide necessary protection against damage. * During spring, a low-level inversion may cause extremely anomalous radar and radio propagation below the inversion. Consequently, helicopters may be out of radio contact at a range of one or two miles.
	(3) Anchored - small-ship buoy array.	(a) Wind reaches the mooring buoys, but has little effect on ships moored at mooring-buoy array. * While ships in the nearby anchorage may have to use engines to prevent dragging anchor, the substantial anchors used with mooring buoys should prevent problems of a similar nature. * During spring, a low-level inversion may cause extremely anomalous radar and radio propagation below the inversion. Consequently, helicopters may be out of radio contact at a range of one or two miles.
	(4) Anchored - Souda Bay.	(a) Wind reaches the anchorage. * Ships may have to use engines during strongest winds to prevent anchor dragging. * During spring, a low-level inversion may cause extremely anomalous radar and radio propagation below the inversion. Consequently, helicopters may be out of radio contact at a range of one or two miles.
	(5) Anchored - outer bay.	(a) Wind reaches the anchorage with full force, and may cause anchor dragging. * Ships can get limited protection by moving closer inshore near Cape Dhrápanon. * Bottom is very rocky closer inshore. * During spring, a low-level inversion may cause extremely anomalous radar and radio propagation below the inversion. Consequently, helicopters may be out of radio contact at a range of one or two miles.

Table 2-1. (continued)

HAZARDOUS CONDITION	INDICATORS OF POTENTIAL HAZARD	VESSEL I SITUATI
		(6) <u>Arr dep</u> (7) <u>Sma</u>
2. <u>W to NW'ly winds</u> - * May occur any month. * Events occuring during late spring, summer or early autumn are called Etesian or meltemi. * Reaches the facilities within Soúda Bay with strengths to 25 kt. Gale force possible. * Wind does not reach the outer anchorage, but 7-10 ft (2-3 m) swell waves generated by N'ly winds over Aegean Sea do, resulting in near calm conditions with 7-10 ft swell.	<u>Advance warning</u>. * Reports of strong N'ly winds over the Aegean Sea during all months of year. * Common occurrence during late spring, summer, and autumn.	(1) <u>Moo Bas</u> (2) <u>Moo pie</u> (3) <u>Anch ship</u> (4) <u>Anc Bay</u> (5) <u>Ancl bay</u>

ble 2-1. (continued)

AREAS OF HAZARD	VESSEL LOCATION/ SITUATION AFFECTED	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS
n i	(6) Arriving/ departing.	(a) Ships arriving at or departing from Soúda Bay may experience intermittently strong winds along the N coast of Crete as they pass areas where deep passages exist in the E-W ridge of mountains on Crete. * Ships inbound to the Naval Base or fuel pier may experience mooring delays because of strong winds. * Ships inbound to the anchorage in Soúda Bay or outer anchorage should be aware of anchor dragging problems due to strong winds. * Ships inbound to the outer anchorage may get limited protection by moving closer inshore near Cape Dhrápanon. * Ships inbound to the inner anchorage may need to use engines to prevent anchor dragging. * During spring, a low-level inversion may cause extremely anomalous radar and radio propagation below the inversion. Consequently, helicopters may be out of radio contact at a range of one or two miles.
bo	(7) Small boats.	(a) Small boat operations may be curtailed to/from ships in the inner and outer anchorages. * Operations within the naval base and to/from the mooring buoy array would be minimally affected.
ong N'ly winds n Sea during year. nce during mmer, and	(1) Moored - Naval Base.	(a) Wind reaches Naval Base, but has little effect on moored ships. * Adding or doubling of mooring lines should provide necessary protection against damage.
	(2) Moored - fuel pier.	(a) Wind reaches the fuel pier, but has little effect on moored ships. * Adding or doubling of mooring lines should provide necessary protection against damage.
	(3) Anchored - small-ship buoy array.	(a) Wind reaches the mooring buoys, but has little effect on ships moored at mooring-buoy array. * While ships in the nearby anchorage may have to use engines to prevent dragging anchor, the substantial anchors used with mooring buoys should prevent problems of a similar nature.
ed	(4) Anchored - Soúda Bay.	(a) Wind reaches the anchorage. * Ships may have to use engines during strongest winds to prevent anchor dragging.
ed	(5) Anchored - outer bay.	(a) The wind does not reach the anchorage with any significant velocity, but the anchorage is affected by swell waves to 10 ft (3 m) which are generated over the Aegean Sea N of Crete. * The result is often calm winds and 10 ft (3 m) waves at the anchorage.

Table 2.1 (continued)

HAZARDOUS CONDITION	INDICATORS OF POTENTIAL HAZARD	VESSEL LO SITUATION
		(6) Arriv depar
		(7) Small
3. N'ly winds/waves - * Primarily a late autumn, winter, and early spring event. * Affects the outer anchorage.	Advance warning. * An indicator of storm approaching from N is a cloud over Mt. Zoúrva Paúpa, S of Soúda Bay.	(1) Anchor bay.
		(2) Arrivi depart
		(3) Small b

Table 2.1 (continued)

TIO S OF FE AZARD	VESSEL LOCATION/ SITUATION AFFECTED	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS
∠ g.	(6) Arriving/ departing.	(a) Ships arriving at or departing from Soúda Bay may experience strong N'ly winds along the N coast of Crete. * Ships inbound to the Naval Base or fuel pier may experience mooring delays because of strong winds. * Ships inbound to the anchorage in Soúda Bay should be aware of anchor dragging problems due to strong winds. * Ships may need to use engines to prevent anchor dragging.
ats	(7) Small boats.	(a) Small boat operations may be curtailed to/from ships in the inner and outer anchorages. * Operations within the naval base would be minimally affected.
storm N is a urva Paúpa,	(1) Anchored - outer bay.	(a) Wind and waves reach the outer anchorage. * Vessels may drag anchor in a strong event. * Closest relief from N'ly conditions can be found in Soúda Bay in lee of Akrotiri Peninsula.
g.	(2) Arriving/ departing.	(a) Vessels inbound and outbound of Souda Bay will be exposed to full effects of northerl con- ditions when north and east of Souda Bay in the Cretan Sea. * Wind and waves reach the outer anchorage. * Anchor dragging possible. * If feasible, vessels should anchor in Souda Bay in the lee of Akrotiri Peninsula.
s.	(3) Small boats.	(a) Wind and waves reach the outer anchorage. * Small boat operations to and from outer an- chorage may be precluded.

SEASONAL SUMMARY OF HAZARDOUS WEATHER CONDITIONS

WINTER (November through February):

* Westerly winds reach the port area after being funneled through a valley west of the port.
  * May affect berthing operations.
  * May cause anchor dragging in Soúda Bay.
* Northerly winds/waves reach the outer anchorage.
  * An indicator of forthcoming northerly winds is a cloud over 1,969 ft (600 m) Mount Zoúvra, Poupa, south of Soúda Bay.
* Strong southeasterly winds are possible. See spring section below.

SPRING (March through May):

* Early spring is similar to winter.
* Strong southeasterly winds may occur, lasting 1-2 days.
  * Most common during April/May.
  * Swell to 13 ft (4 m) in outer anchorage, 5 to 7 ft (1-1/2 to 2 m) in Soúda Bay.
  * Local indicator of southeasterly winds is an east-west line of altostratus clouds parallel to the coasts west of Cape Dhrápanon and city of Rethimnon.
* Scirocco conditions (low clouds, drizzle, and possible "muddy" precipitation) are at yearly maximum frequency of occurrence.
  * Anomalous radar/radio propagation is possible.
* Westerly Etesian winds reach the port area by season's end and may affect berthing operations and cause anchor dragging.

SUMMER (June through September)

* Westerly Etesian winds are common.
  * May reach gale force.
  * May cause anchor dragging.
  * Berthing operations may be affected.
* Strong southeasterly winds may occur, lasting 1-2 days.
  * Most common during September/October).
  * Swell to 13 ft (4 m) in outer anchorage, 5 to 7 ft (1-1/2 to 2 m) in Soúda Bay.
  * Southeast winds, with dust, may become gusty with variable direction near bay entrance.

AUTUMN (October)

* Transitional season. Winter conditions (see above) will prevail by end of month.
* Strong southeasterly winds may occur, lasting 1-2 days.
  * Most common during September/October). Swell to 13 ft (4 m) in outer anchorage, 5 to 7 ft (1-1/2 to 2 m) in Soúda Bay.

NOTE: For more detailed information on hazardous weather conditions, see previous Table 2-1 in this section and Hazardous Weather Summary in Section 3.

PORT VISIT INFORMATION

MAY 1990: NOARL Meteorologists R. Fett and R. Miller met with Port Officer and Pilot, Capt. A. Bayada to obtain much of the information included in this port evaluation.

3. GENERAL INFORMATION

This section is intended for Fleet meteorologists/ oceanographers and staff planners. Paragraph 3.5 provides a general discussion of hazards and table 3-1 provides a summary of vessel locations/situations, potential hazards, effect-precautionary/evasive actions, and advance indicators and other information about potential hazards by season.

3.1 Geographic Location

The island of Crete is located in the northwest portion of the eastern Mediterranean Sea. Crete forms the southern limit of the Cretan Sea (Figure 3-1).

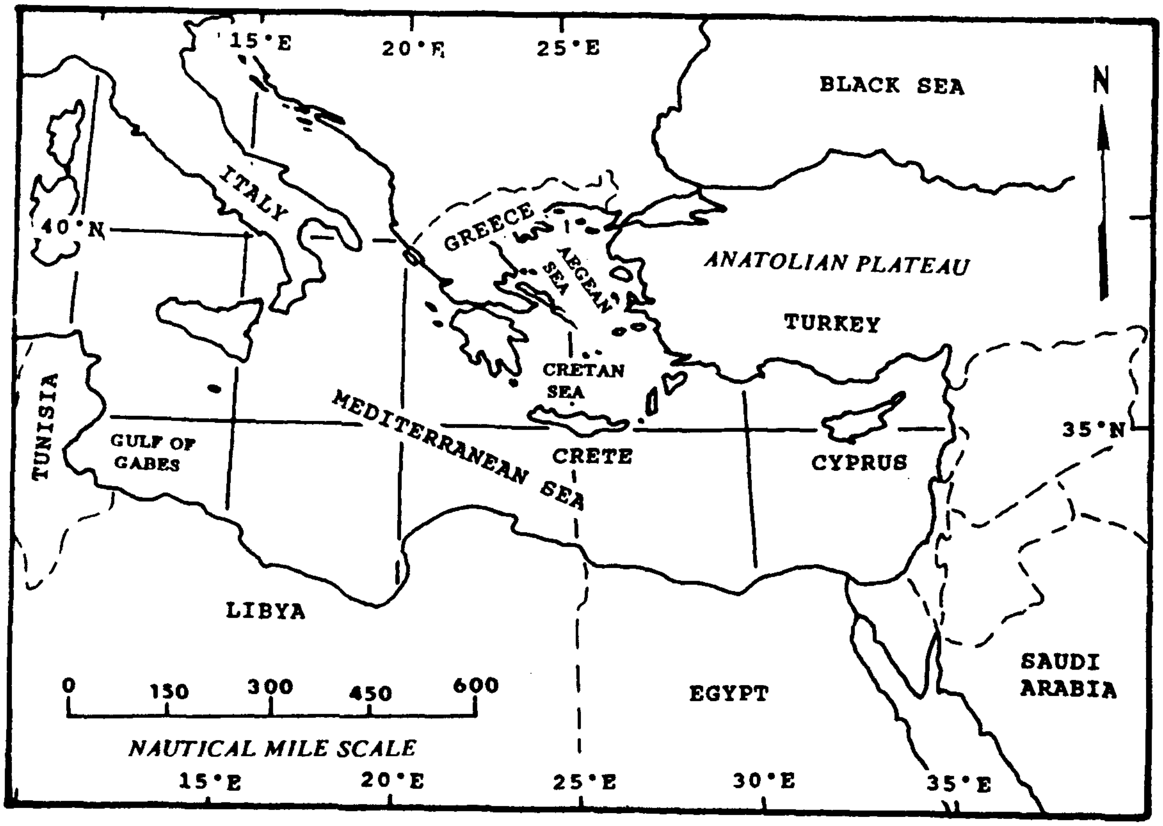

Figure 3-1. Central and Eastern Mediterranean Sea.

Soúda Bay is located on the north coast of Crete at approximately 35°29'N 24°11'E (Figure 3-2). The topography of Crete is rugged and very mountainous, with one peak about 15 n mi south southeast of the port reaching 8,048 ft (2,453 m). A backbone of mountains exceeding 3,000 ft (914 m) extends east-west the length of the island, with a few north-south valleys cutting deep passages through the mountains.

A low range of mountains, with a mean height of about 1,000 ft (305 m) lies along the north side of the Akrotiri Peninsula. The peninsula is connected to the main island of Crete by a low-lying strip of land which forms a valley west of Soúda Bay.

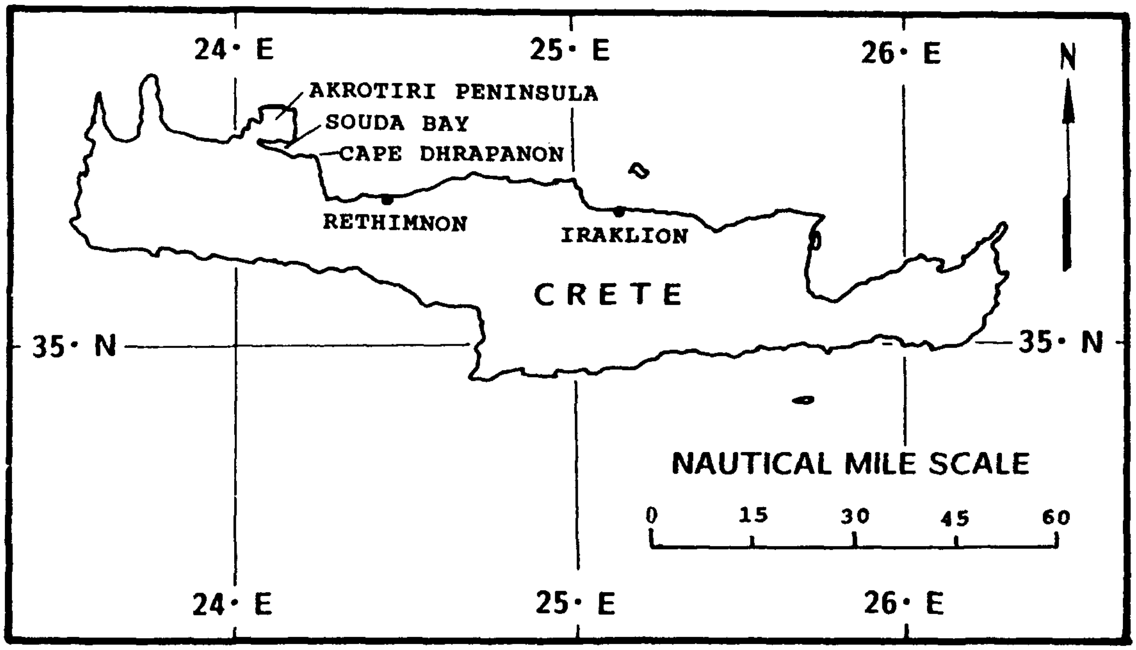

Figure 3-2. Crete

The main facilities of the port lie at the west end of Soúda Bay, south of the Akrotíri Peninsula (Figure 3-3).

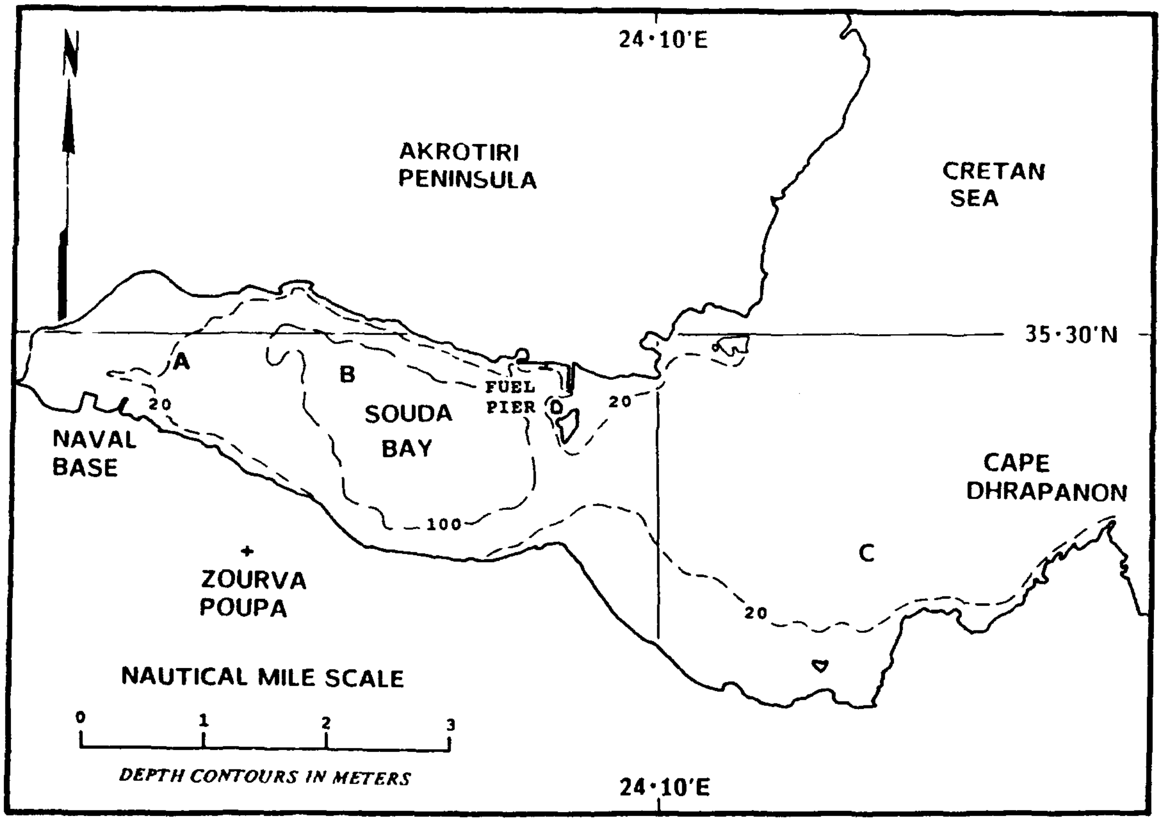

Figure 3-3. Souda Bay, Crete

The pier area at Soúda Bay is primarily a Hellenic Navy Base, but a commercial pier is designated. Specific information regarding lengths of berths in the port is not available. However, only small ships can be accommodated, and alongside depths are limited to 33 ft (10 m). A fleet landing is established at the location specified in Figure 3-4.

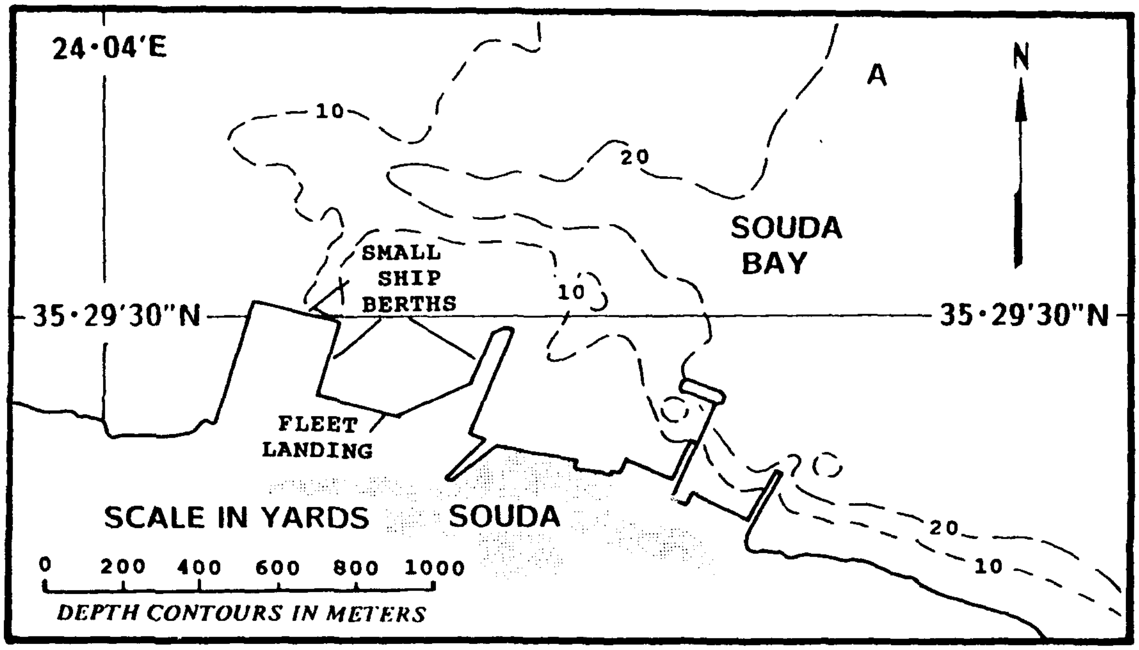

Figure 3-4. Souda Bay Naval Base.

A fuel pier is located on the north side of Soúda Bay approximately 3 1/2 n mi east of the main portion of the port (Figure 3-3). The concrete fuel quay is 450 ft (137 m) long with an axis of 100/280° (FICEURLANT, 1987).

Three anchorages exist at/near Soúda Bay. A small-ship anchorage (mooring buoy array), indicated by the letter "A" on Figures 3-3 and 3-4, is located at the west end of Soúda Bay about 0.3 to 0.8 n mi northeast of the Naval Base. A second anchorage, referred to as the inner bay anchorage and indicated by the letter "B" on Figure 3-3, is located in Soúda Bay approximately 1.9 n mi east of the Naval Base in depths of 390-490 ft (119-149 m). This anchorage is used by aircraft-carrier sized vessels for liberty visits. The inner bay anchorage bottom is rock and gravel with only fair holding qualities. Anchor dragging is possible; ships may have to use their engines to maintain position in the anchorage. The fleet landing at the Naval Base is used by small boats from ships using the inner bay anchorage.

A third anchorage, referred to as the outer anchorage and indicated by the letter "C" on Figure 3-3, is situated outside Souda Bay, 6 to 7 n mi east of the main port area. The depth is about 215 ft (66 m). This anchorage is used primarily for limited personnel and supply transfer from the Naval Base. The bottom is flat with rock and gravel. Holding is only fair; anchor dragging may be experienced in strong winds. The fleet landing at the fuel pier is used by small boats from ships at this anchorage.

3.2 Qualitative Evaluation of the Port of Soúda Bay

The inner portion of Soúda Bay provides excellent protection from open sea wave motion, but offers little protection from strong westerly winds. The primary wind problem in the port is caused by west to west-northwesterly winds which become super-gradient after funnelling through the valley west of the port. The wind can cause problems with berthing operations.

The outer anchorage is exposed to strong southeasterly winds, but a short move to a nearby area closer to the shore provides limited protection. During summer strong Etesian (also called Meltemi) wind events (NW at Souda Bay), 7-10 ft swell reaches the outer anchorage but high winds are seldom experienced. Movement toward the head of the Bay will reduce exposure to both wind and waves.

3.3 Currents and Tides

Tides are limited to 2 ft (60 cm), with no unusual tide fluctuations. Currents are negligible, and have no significant effect on navigation.

3.4 Visibility

Visibility is generally good at Soúda Bay. Fog is rare. It was observed for the first time in 12 years in 1989, and again in 1990. A February occurrence, visibility was reduced to 100 yd, and created problems for small boats coming to the pier. The fog never completely cleared during the day.

3.5 Hazardous Conditions

Because of the orientation of the bay, winds from west and southeast pose the greatest problems for the port. Westerly winds can occur at all times of the year with strengths up to 25 kt common. Gale force is possible. Southeasterly winds can occur any time of the year, but primarily during the April to October period, and are more frequent during April/May and September/October.

Southerly winds are very gusty in Soúda Bay, and sometimes interrupt boat traffic between anchorages and the shore, especially from January to March. On the northern shore

the wind is often very different from the wind outside the bay or in the center of the bay (Hydrographer of the Navy, 1968).

Maximum swell in the anchorages varies by location. The outer anchorage may experience swell to 13 ft (4 m) with strong southeast winds, while the anchorages in the inner portion of Soúda Bay are limited to 5 to 7 ft (1-1/2 to 2 m).

Approximately 27.8 inches of precipitation is recorded at Soúda Bay during an average year. Figure 3-5 shows the annual distribution of precipitation.

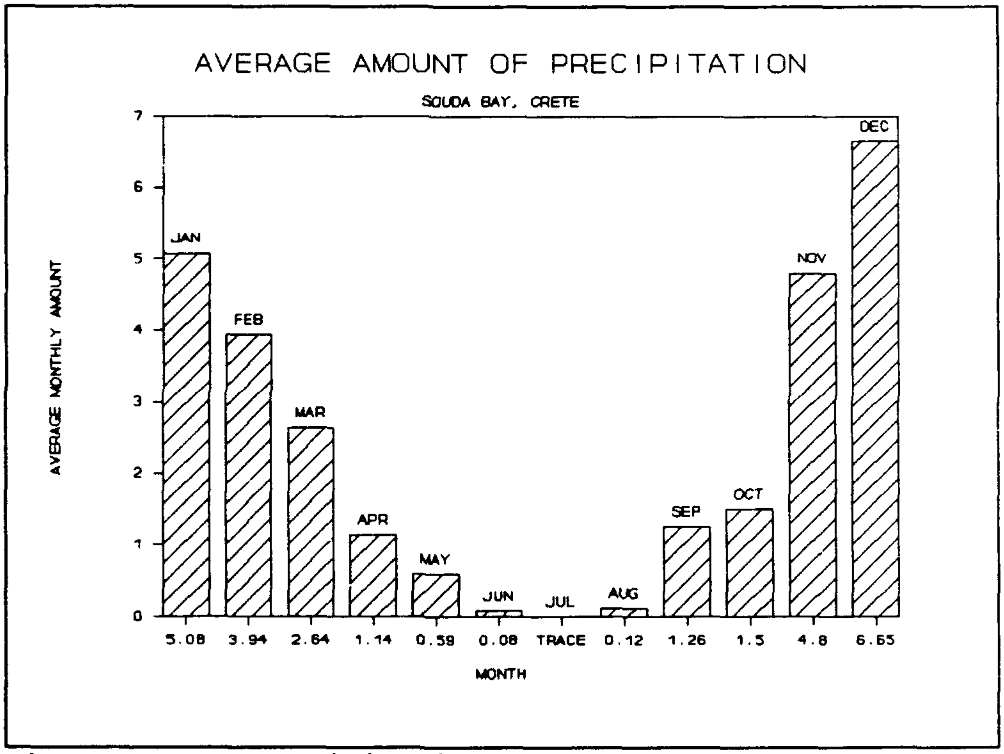

Figure 3-5. Precipitation. (After U.S. Naval Oceanography Command Detachment, Soúda Bay, Greece, 1987.)

Thunderstorms rarely occur at Soúda Bay from June to August. They may occur during the remainder of the year, but they occur most frequently (an average of four times per year) during the October to December period due to the warmer sea surface temperatures. Hail is infrequent. The mountainous terrain of Crete provides the necessary lifting in convectively unstable air masses to produce thunderstorms. Although they may

be associated with cold fronts and troughs, they are more commonly associated with conditions in advance of cold core lows moving slowly eastward out of the central Mediterranean.

A seasonal summary of various known environmental hazards that may be encountered in the Port of Soúda Bay follows.

A. Winter (November through February)

The winter season commences abruptly with the breakdown of the Azores high over central Europe. The Eurasian land mass north of Crete is very cold in comparison with the sea surface temperatures of the eastern Mediterranean Sea. In general, low pressure dominates the Mediterranean basin, and is blocked by the Siberian high to the northeast and the Bermuda/Azores high to the west. The polar jet stream is located generally over the southern Mediterranean Sea in winter and cyclonic activity, unsettled weather, and strong winds are common. The winters at Soúda Bay are mild and rainy with temperatures usually remaining within a few degrees of the surrounding sea temperature (U. S. Naval Oceanography Command Detachment, Soúda Bay, Greece, 1987).

The primary extratropical storm track in the Mediterranean becomes well established by late November. The track starts with cyclogenesis in the Gulf of Lion or Gulf of Genoa, and moves southeastward across southern Italy and Greece before recurving northeast into northern Turkey or the Black Sea. A secondary winter storm track, most prevalent from February through April, starts with lows developing south of the Atlas Mountains of North Africa, and moving eastward along the coast or into the Mediterranean basin.

January through March is the stormiest period of the year at Soúda Bay, with frequent gales and heavy rain not uncommon (FICEURLANT, 1987). Cyclonic activi-

ty affecting Crete and the eastern Mediterranean occurs from the systems discussed above as well as systems developing in the Cyprus area just south of the coast of Turkey. Systems moving toward the eastern Mediterranean from the Gulf of Lion or Gulf of Genoa often leave the central Mediterranean only to stall off of the west coast of Greece. In order for rapid redevelopment to occur, one requirement is a vigorous invasion of cold air from the Aegean Sea. If a low develops along the leading edge of the cold surge, it may at first move south or southwest before it moves eastward to the Cyprus area. Cyclogenesis over the southern Aegean Sea/Cretan Sea is most likely to occur during autumn and winter.

If cyclogenesis occurs and the trough of low pressure extends southward into North Africa, a scirocco (see section 3.5.A.(1)(c) below) can be expected ahead of the cyclone. Heavy showers with poor visibility are likely along and behind the cold front. Gale force winds are most likely north of the low center within the cold surge, but can also occur west of the low.

(1) <u>Southeasterly winds</u>. Southeasterly winds commonly occur during the April to October period, but are more frequent during April/May and September/October. Strong episodes occur 3 to 4 times per year and last 1 to 2 days. As described in the following text which has been extracted from Naval Oceanography Command Detachment, Soúda Bay, Greece (1987), the winds can be caused by different synoptic situations.

(a) <u>Lows moving south of Crete</u>. The type of weather experienced with a low on a trajectory south of Crete is dependent on the origin of the low, its intensity, and the relative temperatures of the air and sea. Lows originating from the Gulf of Genoa or

Gulf of Lion that subsequently move south of Crete normally produce more precipitation than those that originate in North Africa. Showers and thunderstorms can be expected in the warm sector of the low, accompanied by brisk east to southeast winds. Due to the relatively warmer sea temperature, thunderstorm activity is most likely to occur during the early winter months. As the low moves east of Crete, surface winds at Soúda Bay back to north, with partial clearing to be expected with 4 to 6 hours.

(b) Lows moving north of Crete. During the winter months, lows passing north of Crete follow a mean path across southern Greece and are frequently accompanied by a cold front, which is followed by a series of short wave troughs. Brisk south to east winds blow across Crete in the warm sector of the circulation. Precipitation is primarily confined to showers and thunderstorms associated with the cold front and post-frontal troughs. Overall weather conditions improve sooner after passage than occurs with a low passing south of Crete. Lows passing north of Crete are most common in autumn and early winter as the primary storm track begins its progression southward.

(c) North African lows. North African lows develop over the desert region south of the Atlas mountains. The synoptic situation favoring development is the presence of an upper trough lying over Spain with its axis lying northeast-southwest, producing a deep south-westerly flow over northwest Africa. The presence of a cold front is apparently immaterial for the development of a low, but when one is present, development usually occurs before the front reaches the mountain range.

The amount of precipitation and the speed of movement with these systems is related to the time of year in which they develop. During late autumn and early winter, lows moving out of this area are noted for their extremely slow movement due to their association with a cut-off low aloft. During this period, precipitation amounts will be relatively high because of the abundance of moisture available from the relatively warm sea surface.

During late winter and early spring, as the number of North African cyclones increases, North Africa becomes the primary cyclogenesis area for the region. Unlike lows developing early in the winter, these lows are generally associated with open, short wave troughs. They produce little precipitation, but frequently produce high winds in close proximity to their centers. Their increased speed of movement compared with the early winter systems also make them unique. Some lows have been noted to move eastward out of North Africa at 40 to 50 kt. With the scarcity of reports along the cyclogenesis area, the use of satellite data over the region may be the only clue to the presence of a developing low.

When the low emerges over the Mediterranean, the 500 mb chart is a good guide to determining the likely direction of movement. Should the low take a course toward the eastern Mediterranean, the associated Scirocco conditions will spread progressively eastward along the northeast African coast, remaining confined to the eastern side of the associated front. Scirocco conditions vary by season, with the most bothersome effects occurring during spring. Wintertime Scirocco conditions include relatively warm temperatures and stable conditions (low stratus, fog, and drizzle with reduced visibility) in the lower levels of

the atmosphere. Although more common in spring, anomalous radar and radio propagation may occur due to a strong low-level inversion.

(2) Northerly winds. Winter northerlies may be established in the Aegean by the eastward passage of a surface low pressure system, with associated cold front, over central or southern Greece. The winds veer to north or northwest with frontal passage. This pattern can develop witnout cyclogenesis occurring south of Turkey, but the pattern is likely to be stronger and more persistent with cyclogenesis occurring.

During periods of low zonal index (late autumn through spring), lows frequently form and become stationary near Cyprus. These systems develop in the lee of the Taurus Mountains of Turkey between the Gulf of Antalya to Cyprus, and become most intense from November through April. Factors associated with the development of an intense Cyprus low pressure system are similar to those associated with cyclogenesis in the Gulf of Genoa:

(a) The thermal contrast between land and water.

(b) Interaction between the sub-tropical and polar jet streams.

(c) Effect of northerly flow over the mountains of Turkey enhancing cyclogenetic activity along the southern slopes.

(d) Northern topographic features which block a cold front's southward movement.

The weather to the west of these systems (i.e. near Crete) is characterized by strong-to-gale force squally winds and heavy showers. While the low (including cut-off lows) remains east of Crete, short wave troughs frequently develop north of the area, spiraling south and eastward around the stationary low, causing

periods of showers locally. Usually, surface winds back to the northwest and decrease as the troughs approach and brief clearing sometimes occurs prior to the arrival of showers. After trough passage, winds again veer to northeast and increase in velocity. This cycle occasionally repeats itself a half dozen times in as many days before the low fills or moves on.

Winter temperatures at Soúda Bay are not severe. During January, the coldest month, the average temperature at the weather office at NOCD Soúda Bay (480 ft above MSL on the Akrotíri Peninsula) is 51°F (11°C) (U. S. Naval Oceanography Command Detachment, Souda Bay, Greece, 1987). The mean maximum temperature is 58°F (14°C), while the mean minimum temperature is 45°F (7°C). The absolute minimum temperature recorded at NOCD is 32°F (0°C).

Precipitation amounts and frequency of occurrence are greatest during winter, with an average of 6.65 inches of rain falling during December, the wettest month of the year. See Figure 3-5.

B. Spring (March through May)

The spring season is noted for periods of stormy winter-type weather that alternates with false starts of summer-type weather (Brody and Nestor, 1980). The early portion of the season is much like winter, but as the season progresses through April, the weather moderates considerably. By the end of the season, summer weather prevails.

Cyclonic activity, as discussed in section 3.5.A above, is common through the first part of the season, but becomes less frequent and less intense as summer nears. North Africa becomes a primary cyclogenesis region as low activity increases during late winter and early spring. During spring the sea

is relatively cool, and as the warm air in advance of a low pressure system moves northward, a substantial inversion is created between the surface and approximately 3,000 ft. Above the inversion the air is unstable. With light winds, low stratus forms, increasing in amount as it moves further north. When the winds are strong, vast amounts of dust are trapped beneath the inversion. The instability over the inversion creates high-based cumulus and cumulonimbus clouds which will produce small amounts of very muddy precipitation.

During spring, the low-level inversion causes extremely anomalous radar and radio propagation below the inversion. Consequently, helicopters may be out of radio contact at a range of one or two miles.

Etesian winds (see section 3.5.C below) become common during the last portion of the season, and resultant westerly winds affect the port.

Precipitation decreases sharply during spring, with an average of less than one inch of rain measured during an average month of May. See Figure 3-5.

C. Summer (June through September)

The monsoonal effect of the summer season leads to the development of an intense heat trough over southern Asia that extends westward over Turkey. Higher pressure dominates over the relatively cooler surface of the Mediterranean Sea, and settled, dry weather persists. Etesian winds, also called meltemi, dominate the eastern Mediterranean during summer and are the most common winds of significant velocity during summer at Soúda Bay. Defined as northerly winds prevailing during summer in the Aegean Sea and the eastern Mediterranean, the Etesian winds that affect Crete are a southeastward extension of the northerly

wind regime over the Aegean Sea. Northerly winds prevail along the Greek coast during the winter also, but only those northerly winds occurring between May and November are considered Etesians. Etesians are at their maximum strength during July and August. The pressure gradients necessary to drive the Etesian winds result from a combination of:

(1) The monsoonal effect during the summer that leads to a low pressure trough over Turkey. Etesian winds flow from a high pressure ridge over the Balkans toward the trough. During a strong Etesian, the trough may extend relatively far to the west and beyond Rhodes. It may also form a closed low, resulting in almost calm winds at Rhodes.

(2) Synoptic conditions leading to anti-cyclogenesis over the Balkans.

(3) A jet-effect wind increase caused by channelling of the wind between islands and mountain valleys. These effects tend to render wind reports from certain locations unrepresentative. In the lee of Crete, katabatic flow off the mountains generates gusty winds similar to the Foehn of the Alps. The mountain valleys tend to channel the flow which increases the wind velocity. Strong or gale force winds are frequent along the southern coast of Crete during the Etesian season in areas where they are channelled.

At Soúda Bay, Etesian winds are from the northwest quadrant (U. S. Naval Oceanography Command Detachment, Soúda Bay, Greece, 1987). The northwest winds would likely reach the port area as west-northwesterly due to the higher terrain north and south of the bay, and the valley to the west. FICEURLANT (1987) states that an occasional westerly gale may occur during the summer.

The surface flow is generally divergent in an Etesian situation, and the weather is generally thought to be dry with clear skies. However, this is mostly true only during July and August. During this peak Etesian period, scattered altocumulus appear a day before an Etesian, and the only other clouds are orographic types that may form in the lee of islands in stronger Etesians. During the early and late months of the Etesian season, thunderstorms frequently occur both ahead of and behind the front over the Balkans, often in northern Greece, and sometimes as far south as Athens. The thunderstorms frequently precede the Etesian by one day and generally continue for an additional 24 hours.

Local authorities stated that southeast winds, with dust, that have their origins over North Africa near Libya are also experienced during summer. Slight changes in direction of the southeast wind can cause large changes of wind near the bay entrance. If the wind is calm in the bay, but southeast outside of the bay, wind speed may suddenly increase if the direction changes slightly. Meteorologists need to be observant for sudden onset of southeast winds, with one reliable indicator being an east-west line of altostratus which is parallel to the coast west of Cape Dhrápanon and Réthimnon (see Figures 3-2 and 3-3).

Land and sea breezes are prominent in summer when the Etesian winds are not very strong. The land breeze is a light westerly wind and blows in the early morning. The sea breeze blows up the bay in the afternoon until near sunset when it becomes calm (Hydrographer of the Navy, 1968).

Summer temperatures at Soúda Bay are quite warm. During July, the warmest month, the average temperature is 79°F (26°C), while the mean maximum

temperature is 87°F (31°C) and the mean minimum temperature is 69°F (21°C). The absolute maximum temperature recorded at NOCD Soúda Bay is 112°F (44°C) (U. S. Naval Oceanography Command Detachment, Soúda Bay, Greece, 1987).

Precipitation amounts are at an annual minimum during summer, with only a trace being recorded during July, the driest month. See Figure 3-5.

D. Autumn (October)

Autumn is a transitional season at Soúda Bay, lasting only for the month of October. It results in an abrupt change from summer weather to the unsettled weather of winter (Brody and Nestor, 1980).

By the end of the month, most of the low pressure systems discussed in section 3.5.A above are possible in the Mediterranean basin. Lows moving south of Crete are most likely to cause thunderstorm activity during the autumn months due to the sea surface temperature still being relatively warm.

Precipitation amount and frequency start to increase as the winter season approaches. See Figure 3-5.

3.6 Harbor Protection

3.6.1 Winds and Weather

Although protected from significant winds from most directions by the surrounding topography, westerly winds funnel between the main island of Crete and the Akrotiri Peninsula and can cause berthing problems at the port. Westerly winds can occur at all times of the year with strengths up to 25 kt not uncommon and gale strength possible. In one case, pilots would not berth a U. S. Navy ship at the fuel pier because of the strong wind.

Also, passenger ferries must sometimes wait for winds to decrease before berthing.

Strong westerly and southeasterly winds can cause vessels using the inner harbor anchorage to drag anchor. Ships may have to use their engines to maintain position.

Southeasterly and northerly winds can cause anchor dragging for ships using the outer anchorage. Limited protection from southeasterly winds can be obtained by moving south to near Cape Dhrápanon. The bottom in the area closer to the shore is very rocky.

3.6.2 Waves

Northerly winds generate waves which reach the outer anchorage during the winter months. Although summer time Etesian (meltemi) winds do not reach the outer anchorage, they generate 7 to 10 ft (2 to 3 m) northerly swell over the Aegean Sea which propagates to the anchorage. The result is a near calm condition with 7 to 10 ft (2 to 3 m) swell.

Southeasterly winds can raise swell to 13 ft (4 m) at the outer anchorage, but the swell is limited to about 5 to 7 ft (1-1/2 to 2 m) in the inner bay. If accompanied by strong winds, anchor dragging may occur, and the precautions specified in section 3.6.1 above may be required.

3.7 Protective and Mitigating Measures

3.7.1 Moving to a New Anchorage

Southeasterly winds. When strong southeasterly winds make remaining in the outer anchorage inadvisable due to anchor dragging or other problems, moving south to near Cape Dhrápanon may provide limited protection. The bottom in the coastal waters near Cape Dhrápanon is very rocky--so much so that fisherman do not use nets in the area.

Vessels using the anchorage in the inner portion of Soúda Bay may experience anchor dragging due to strong southeast-

erly winds, and may have to use their engines to maintain position.

Northerly winds/waves. The outer anchorage is exposed to northerly winds and waves. The closest relief from northerly conditions can be found in Soúda Bay in the lee of Akrotíri Peninsula.

3.8 Local Indicators of Hazardous Weather Conditions

Southeasterly winds - An indicator of southeasterly winds is an east-west line of altostratus clouds parallel to the coasts west of Cape Dhrápanon and the city of Réthimnon. The indicator is considered to be a very reliable indicator and is highly regarded by local fishermen.

Scirocco - A good indication of the start of a Scirocco in the eastern Mediterranean is the development of strong southerly winds at stations along the northeast coast of Libya (Brody and Nestor, 1980).

Unless otherwise indicated, the following guidelines are taken from the Local Area Forecasters Handbook, Soúda Bay, Greece, prepared for Commander, Naval Oceanography Command, NSTL Station, Bay St. Louis, MS 39529 by U. S. Naval Oceanography Command Detachment, Soúda Bay, Greece (1987).

Northerly winds - When the gradient surface wind flow across the Aegean is less than 10 kt from due north to slightly northeast, Soúda Bay will experience northwest winds.

Local authorities state that during the winter, an indicator of a storm approaching from the north is a cloud over 1,969 ft (600 m) Mount Zoúrva Poúpa, just south of Soúda Bay (Figure 3-3).

Southerly Winds. If the gradient ahead of an eastbound disturbance causes the winds to be from a due south direction, the mountains to the south will partially block them. In this case, while Iráklion will be experiencing super-gradient winds due to channeling, Soúda Bay will have light southerly winds.

However, as the winds shift slightly to the southwest, they will increase to gradient speeds, sometimes suddenly, and they may be quite gusty.

Miscellaneous

The island of Milos, located about halfway between Soúda Bay and Athens, is a fairly reliable indicator for conditions that will occur at Soúda Bay associated with troughs and fronts moving down from the north.

The most reliable wintertime thunderstorm forecasting aid for Soúda Bay is the minus 20°C isotherm at the 500 mb level. Generally, expect thunderstorms to develop along a front or trough if this isotherm lies south of Soúda Bay. This aid is most reliable during the winter season. Thunderstorms during autumn can occur with a warmer 500 mb temperature due to the added instability provided by a relatively warmer sea surface.

In addition to the foregoing, the following rules, which have been taken from Brody and Nestor (1980), give some insight to the development of hazardous weather conditions at Soúda Bay.

Etesian

During an Etesian, gale force winds extend into the area just east of Crete and south of Rhodes. Northerly winds 20-25 kt in the Aegean Sea increase to 25-32 kt with higher gusts off the coast of eastern Crete.

Etesian winds in the sea area east of Crete are 100% of the geostrophic speeds due to the channeling effect between Crete and the neighboring island of Carpathos. The direction of the flow is across the isobars at an angle of approximately 45° toward lower pressure.

Gale force winds are likely along the south coast of Crete during an Etesian. Orographic wave clouds along

the mountains of Crete are an indication of strong winds to the south.

North African lows

Increasing southeasterly winds at Soúda Bay are an indication that a North African cyclone is moving toward Crete (Brody and Nestor, 1980).

Strong surface ridging eastward across Morocco is an indication that a North African cyclone will move/develop over Tunisia, east of the Atlas Mountains. If surface winds at Algiers shift from southwest to northwest in association with the ridging, cyclogenesis will occur east of the Atlas Mountains.

The strongest winds associated with a deepening North African low, after the system moves out over the Mediterranean, occur in the northwest sector of the system rather than in the eastern sector.

The strongest winds associated with a deepening North African low, after the system moves out over the Mediterranean, occur in the northwest sector of the system rather than in the eastern sector.

Cyclone movement. Cyclones developing on the southern edge of a cold surge over the Aegean Sea may move southward or even southwestward at first, but normally they later will move eastward to the Cyprus area.

Frontal Activity - Cold fronts that move southward through the Aegean Sea usually stall on reaching the latitude of Crete. On the north side of the island, winds are northerly and weather poor with low clouds and drizzle. On the south side of the island, however, winds are southerly with clear skies and warm temperatures. The occurrence of the stationary front along the mountains of Crete can persist up to a week.

Wind direction - The following guidelines apply to conditions observed at the meteorological reporting site at the Soúda Bay airfield, which is located at the 480 ft level, north of Soúda Bay on the Akrotíri Peninsula.

Cold fronts approaching from the west at Soúda Bay do not cause a significant wind change following their passage. Because of the local topography, winds are 270°-290° before and after frontal passages.

The local topography causes basic south to southwesterly flow at the gradient level to be verified as either southeasterly or west-northwesterly flow at station level.

If the expected wind direction is from 270°-010°, the observed direction will be westerly.

If the expected wind direction is from 020°-090°, the observed direction will be easterly.

Observed wind directions along the runway frequently are 180° different from one end to the other.

Haze - Salt haze is a serious problem for flight operations over the Mediterranean. This haze has the following characteristics:

1. It is most prevalent during the summer and early autumn.

2. Its color is bluish white, as opposed to the brown of dust haze.

3. Salt haze scatters and reflects light rays much more than does dust haze.

4. Salt haze sometimes extends to over 12,000 ft and has been reported up to 20,000 ft.

5. Although surface visibility in salt haze may be as high as 4-6 n mi, the slant visibility for a pilot making a landing approach may be near zero, especially if the approach is in the general direction of the sun.

6. Salt haze is sometimes thicker aloft than at the surface.

7. Salt haze is less of a problem after sunset since the poor visibility is caused partially by scattering and reflection of sunlight.

Salt haze is most likely to develop in a stagnant air mass when there is a lack of mixing. It is especially prevalent

when there is a strong ridge present at the surface and aloft. It will not completely disperse until there is a change of air masses such as occurs with a frontal passage. Visibility will improve if there is an increase in the wind speeds at the 850 and/or 700 mb levels.

3.9 Summary of Problems, Actions, and Indicators

Table 3-1 is intended to provide easy-to-use seasonal references for meteorologists on ships using the Port of Soúda Bay. Table 2-1 (Section 2) summarizes Table 3-1 and is intended primarily for use by ship captains.

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Table 3-1. Potential problem situations at the F

VESSEL LOCATION/ SITUATION AFFECTED	POTENTIAL HAZARD	EFFECT - PRECAUTIONARY
1. Moored - Naval Base. 2. Moored - fuel pier. 3. Anchored - small-ship buoy array. 4. Anchored - Soúda Bay Possible in Winter Most common in Spring, late Summer & early Autumn	a.1-4. SE'ly winds/waves. Occurs from April-October, but most frequent during April/May and September/October periods. Strong events occur 3-4 times per year, lasting 1 to 2 days. May raise 7 ft (2 m) waves in Soúda Bay. Rain and/or thunderstorms are possible, with thunderstorms most common during October to November period. Wind occurring during April-August period may bring dust from N Africa.	1.a. Minimal impact on moor mooring lines or doubling of prevent damage if strong win area. During spring, the low-level extremely anomalous radar an below the inversion. Conseq may be out of radio contact two miles. 2.a. The fuel pier is expos winds, but vessels already m rience any problems if adequ used. Ships tie up port sid the wind would be off the st to keep the ship against the the low-level inversion caus radar and radio propagation Consequently, helicopters ma contact at a range of one or 3.a. Wind should reach the cause no significant problem to mooring buoys. During sp inversion causes extremely a radio propagation below the sequently, helicopters may b at a range of one or two mil 4.a. Wind will reach the an have to use engines to preve a strong event. During spri inversion causes extremely a radio propagation below the sequently, helicopters may b at a range of one or two mil
Winter, Spring, Summer & Autumn	b.1-4. W to NW'ly winds. May occur any month. When occurring during late spring, summer, or early autumn, they are called etesian (or meltemi) winds. May reach the port area with strengths to 25 kt, with gale force possible.	1.b. Winds funnel through t port and reach Soúda Bay as hanced W'ly flow. Additiona doubling of existing lines m prevent undue motion of moor 2.b. Ships already moored s significant problems if adeq used. The wind can, and has berthing operations. In one lots would not berth a U.S. wind. 3.b. Strong winds would bl anchorage area but should c problems for ships secured 4.b. Wind will reach the a have to use engines to prev a strong event.

Table 3-1. Potential problem situations at the Port of Souda Bay, Greece - ALL SEASONS

OTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AN ABOUT POTENTIAL
SE'ly winds/waves. from April-October, but requent during April/May ptember/October periods. events occur 3-4 times ar, lasting 1 to 2 days. ise 7 ft (2 m) waves in Bay. Rain and/or thunder- are possible, wit hun- rms most common d ing r to November period. ccurring during April- period may bring dust Afric.	1.a. Minimal impact on moored vessels. Adding mooring lines or doubling of existing lines should prevent damage if strong winds reach the port area. During spring, the low-level inversion causes extremely anomalous radar and radio propagation below the inversion. Consequently, helicopters may be out of radio contact at a range of one or two miles. 2.a. The fuel pier is exposed to strong SE'ly winds, but vessels already moored should not experience any problems if adequate mooring lines are used. Ships tie up port side to the quay walls so the wind would be *off* the starboard bow and tend to keep the ship against the quay. During spring, the low-level inversion causes extremely anomalous radar and radio propagation below the inversion. Consequently, helicopters may be out of radio contact at a range of one or two miles. 3.a. Wind should reach the buoy area, but should cause no significant problems for ships attached to mooring buoys. During spring, the low-level inversion causes extremely anomalous radar and radio propagation below the inversion. Consequently, helicopters may be out of radio contact at a range of one or two miles. 4.a. Wind will reach the anchorage. Vessels may have to use engines to prevent anchor dragging in a strong event. During spring, the low-level inversion causes extremely anomalous radar and radio propagation below the inversion. Consequently, helicopters may be out of radio contact at a range of one or two miles.	a.1-4. SE'ly winds. (1) Local indicator: An indicator of SE'ly altostratus clouds parallel Cape Dhrápanon and the city indicator is considered to indicator that is highly re men. (2) Other indicators: Strong S'ly winds alon is often a precursor of SE' the E Mediterranean. (3) SE winds at Soúda B which are explained in sect including: (a) Lows moving S of C (b) Lows moving N of C (c) N African lows. If the gradient ahead of bance causes the winds to b tains to the S will partial case, while Iráklion will b gradient winds due to chann have light S'ly winds. How shift slightly to SW, they ent speeds, sometimes sudde quite gusty. SE winds, with dust, t over N Africa near Libya ar during summer. Slight chan wind can cause large change entrance to Soúda Bay. If bay, but SE outside of the suddenly increase if the di ly.
W to NW'ly winds. May any month. When occurring late spring, summer, or autumn, they are called n (or meltemi) winds. May the port area with ns to 25 kt, with gale possible.	1.b. Winds funnel through the valley W of the port and reach Soúda Bay as super gradient, enhanced W'ly flow. Additional mooring lines or doubling of existing lines may be required to prevent undue motion of moored vessels. 2.b. Ships already moored should experience no significant problems if adequate mooring lines are used. The wind can, and has, caused problems with berthing operations. In one case on record, pilots would not berth a U.S. Navy ship due to the wind. 3.b. Strong winds would blow directly across anchorage area but should cause no significant problems for ships secured to mooring buoys. 4.b. Wind will reach the anchorage. Vessels may have to use engines to prevent anchor dragging in a strong event.	b.1.4. W-NW'ly winds. Ete meltemi, dominate the E Med mer and are the most common velocity during summer at S N'ly winds prevailing durin Sea and the E Mediterranean that affect Crete are a SE regime over the Aegean Sea. along the Greek coast durir only those N'ly winds occur November are considered ete discussed in detail in sect At Soúda Bay, etesian wi quadrant. The NW winds wou port area as WNW'ly due to and S of the bay, and the sional W'ly gale may occur

at the Port of Souda Bay, Greece - ALL SEASONS

...THER ...ARD	...IONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
ls is the c Réthi a very ied by ne NE sciroc have s 3.5 c e. e. E mov rom du block xperie ng, Sc r, as l incr , and . have lso ex in di f win wind , win tion c	on moored vessels. Adding ...ling of existing lines should ...ong winds reach the port ...w-level inversion causes ...adar and radio propagation ... Consequently, helicopters ...ontact at a range of one or s exposed to strong SE'ly ...ready moored should not expe- ...f adequate mooring lines are ...ort side to the quay walls so ... the starboard bow and tend ...nst the quay. During spring, ...on causes extremely anomalous ...gation below the inversion. ...ters may be out of radio ... one or two miles. ...ch the buoy area, but should ...problems for ships attached ...ring spring, the low-level ...emely anomalous radar and ...ow the inversion. Con- ...s may be out of radio contact ...two miles. ... the anchorage. Vessels may ...o prevent anchor dragging in ...ng spring, the low-level ...emely anomalous radar and ...ow the inversion. Con- ...s may be out of radio contact ...two miles.	a.1-4. <u>SE'ly winds</u>. (1) <u>Local indicator</u>: An indicator of SE'ly winds is an E-W line of altostratus clouds parallel to the coasts W of Cape Dhrápanon and the city of Réthimnon. The indicator is considered to be a very reliable indicator that is highly regarded by local fisher- men. (2) <u>Other indicators</u>: Strong S'ly winds along the NE coast of Libya is often a precursor of SE'ly scirocco winds over the E Mediterranean. (3) <u>SE winds at Soúda Bay have several causes which are explained in section 3.5 of the text, including</u>: (a) Lows moving S of Crete. (b) Lows moving N of Crete. (c) N African lows. If the gradient ahead of an E moving distur- bance causes the winds to be from due S, the moun- tains to the S will partially block them. In this case, while Iráklion will be experiencing super- gradient winds due to channeling, Soúda Bay will have light S'ly winds. However, as the winds shift slightly to SW, they will increase to gradi- ent speeds, sometimes suddenly, and they may be quite gusty. SE winds, with dust, that have their origins over N Africa near Libya are also experienced during summer. Slight changes in direction of the wind can cause large changes of wind near the entrance to Soúda Bay. If the wind is calm in the bay, but SE outside of the bay, wind speed may suddenly increase if the direction changes slight- ly.
in win rrane inds o la Bay summer the ete tensior N'ly wi the wir ng betw ans. F 3.5.C are t likely highe ley to ring th	...rough the valley W of the ...Bay as super gradient, en- ...ditional mooring lines or ...lines may be required to ...of moored vessels. ...oored should experience no ...if adequate mooring lines are ...and has, caused problems with ... In one case on record, pi- ...a U.S. Navy ship due to the ...ould blow directly across ...hould cause no significant ...ecured to mooring buoys. ... the anchorage. Vessels may ...o prevent anchor dragging in	b.1.4. <u>W-NW'ly winds</u>. Etesian winds, also called meltemi, dominate the E Mediterranean during sum- mer and are the most common winds of significant velocity during summer at Soúda Bay. Defined as N'ly winds prevailing during summer in the Aegean Sea and the E Mediterranean, the etesian winds that affect Crete are a SE extension of the N wind regime over the Aegean Sea. N'ly winds prevail along the Greek coast during the winter also, but only those N'ly winds occurring between May and November are considered etesians. Etesians are discussed in detail in section 3.5.C of the text. At Soúda Bay, etesian winds are from the NW quadrant. The NW winds would likely reach the port area as WNW'ly due to the higher terrain N and S of the bay, and the valley to the W. Occa- sional W'ly gale may occur during the summer.

Table 3-1. (Continued)

VESSEL LOCATION/ SITUATION AFFECTED	POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVAS
5. Anchored - outer bay. 6. Arriving/ departing. 7. Small boats. Possible in Winter Most common in Spring, late Summer & early Autumn	a.5-7. SE'ly winds/waves. Occurs during April-October, but most frequent during April/May and September/October periods. Strong events occur 3-4 times per year, lasting 1 to 2 days. May raise 14 ft (4 m) waves in outer anchorage. Rain and/or thunderstorms are possible, with thunderstorms most common during October to November period. Wind occurring during April-August period may bring dust from N Africa.	5.a. Wind will reach the anchorag force and be accompanied by waves 1 May cause anchor dragging. Moving near Cape Dhrápanon will provide l tion and possible better holding o bottom. During spring, the low-le causes extremely anomalous radar a gation below the inversion. Conse copters may be out of radio contac one or two miles. 6.a. Ships may experience intermi winds along the N coast of Crete a areas where deep passages exist in of mountains. Units inbound for t fuel pier may be delayed in moorin winds. Inbound vessels should be tial anchor dragging problems in t See sections 4.a and 5.a above. D the low-level inversion causes ext radar and radio propagation below Consequently, helicopters may be o contact at a range of one or two m 7.a. Strong winds may curtail sma tions to/from ships in the inner a ages. Operations within the naval to/from the mooring buoy array wou affected. 5.b. Etesian (meltemi) wind does reach the anchorage with any signi but N'ly swell generated over the propagates to the anchorage with h ft (2-3 m).
Winter, Spring, Summer & Autumn	b.5-7. W to NW'ly winds. May occur any month. When occurring during late spring, summer, or early autumn, they are called etesian (or meltemi) winds. Etesian winds do not reach the outer bay with any velocity, but N'ly 7 to 10 ft (2 to 3 m) swell from the Aegean Sea reaches the anchorage during July/August resulting in near calm conditions with 7-10 ft swell.	6.b. Ships may experience strong w to 10 ft (3 m) when out of the prot Akrotiri Peninsula. Etesian (melte ing through Soúda Bay do not reach chorage, but associated N'ly swell Sea does, resulting in near calm co swell to 10 ft (3 m). The main, in Soúda Bay experiences strong W wind cause anchor dragging at the anchor ing difficulties at the naval base 7.b. Small boat operations outside of the naval base may not be feasib abate. Passenger ferries must some winds to decrease before berthing i

Table 3-1. (Continued)

POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OT ABOUT POTENTIAL HAZA
. SE'ly winds/waves. 's during April-October, but frequent during April/May eptember/October periods. ıg events occur 3-4 times 'ear, lasting 1 to 2 days. 'aise 14 ft (4 m) waves in · anchorage. Rain and/or ıerstorms are possible, with ıerstorms most common during ıer to November period. occurring during April- ıt period may bring dust N Africa.	5.a. Wind will reach the anchorage with full force and be accompanied by waves to 13 ft (4 m). May cause anchor dragging. Moving closer inshore near Cape Dhrápanon will provide limited protection and possible better holding on a very rocky bottom. During spring, the low-level inversion causes extremely anomalous radar and radio propagation below the inversion. Consequently, helicopters may be out of radio contact at a range of one or two miles. 6.a. Ships may experience intermittently strong winds along the N coast of Crete as they pass areas where deep passages exist in the E-W ridge of mountains. Units inbound for the naval base or fuel pier may be delayed in mooring due to strong winds. Inbound vessels should be aware of potential anchor dragging problems in the anchorages. See sections 4.a and 5.a above. During spring, the low-level inversion causes extremely anomalous radar and radio propagation below the inversion. Consequently, helicopters may be out of radio contact at a range of one or two miles. 7.a. Strong winds may curtail small boat operations to/from ships in the inner and outer anchorages. Operations within the naval base and to/from the mooring buoy array would be minimally affected. 5.b. Etesian (meltemi) wind does not usually reach the anchorage with any significant velocity, but N'ly swell generated over the Aegean Sea often propagates to the anchorage with heights of 7-10 ft (2-3 m).	a.5-7. SE'ly winds. (1) Local indicator: An indicator of SE'ly winc altostratus clouds parallel to Cape Dhrápanon and the city of indicator is considered to be a indicator that is highly regard men. (2) Other indicators: Strong S'ly winds along th is often a precursor of SE'ly s the E Mediterranean. (3) SE winds at Soúda Bay h which are explained in section including: (a) Lows moving S of Crete (b) Lows moving N of Crete (c) N African lows. If the gradient ahead of an bance causes the winds to be fr tains to the S will partially b case, while Iráklion will be ex gradient winds due to channelin have light S'ly winds. However shift slightly to SW, they will ent speeds, sometimes suddenly, quite gusty. SE winds, with dust, that over N Africa near Libya are al during summer. Slight changes wind can cause large changes of entrance to Soúda Bay. If the bay, but SE outside of the bay, suddenly increase if the direct ly.
W to NW'ly winds. May any month. When occurring ıg late spring, summer, or autumn, they are called ın (or meltemi) winds. ın winds do not reach the bay with any velocity, but to 10 ft (2 to 3 m) swell the Aegean Sea reaches the ırage during July/August ıing in near calm conditions with 7-10 ft swell.	6.b. Ships may experience strong winds and seas to 10 ft (3 m) when out of the protection of Akrotíri Peninsula. Etesian (meltemi) winds flowing through Soúda Bay do not reach the outer anchorage, but associated N'ly swell from the Aegean Sea does, resulting in near calm conditions with swell to 10 ft (3 m). The main, inner portion of Soúda Bay experiences strong W winds which may cause anchor dragging at the anchorage and berthing difficulties at the naval base and fuel pier. 7.b. Small boat operations outside the confines of the naval base may not be feasible until winds abate. Passenger ferries must sometimes wait for winds to decrease before berthing in the bay.	b.5-7. W-NW'ly winds. Etesiar meltemi, dominate the E Mediter mer and are the most common wir velocity during summer at Soúda N'ly winds prevailing during su Sea and the E Mediterranean, th that affect Crete are a SE exte regime over the Aegean Sea. N' along the Greek coast during th only those N'ly winds occurring November are considered etesiar discussed in detail in section At Soúda Bay, etesian winds quadrant. The NW winds would l port area as WNW'ly due to the and S of the bay, and the valle sional W'ly gale may occur duri

(Continued)

ONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
the anchorage with full ied by waves to 13 ft (4 m). ging. Moving closer inshore ill provide limited protec- ter holding on a very rocky g, the low-level inversion alous radar and radio propa- rsion. Consequently, heli- radio contact at a range of ience intermittently strong st of Crete as they pass ages exist in the E-W ridge inbound for the naval base or yed in mooring due to strong should be aware of poten- oblems in the anchorages. a above. During spring, or causes extremely anomalous gation below the inversion. ers may be out of radio one or two miles. curtail small boat opera- the inner and outer anchor- n the naval base and array would be minimally wind does not usually th any significant velocity, over the Aegean Sea often rage with heights of 7-10	a.5-7. <u>SE'ly winds</u>. (1) <u>Local indicator</u>: An indicator of SE'ly winds is an E-W line of altostratus clouds parallel to the coasts W of Cape Dhrápanon and the city of Réthimnon. The indicator is considered to be a very reliable indicator that is highly regarded by local fishermen. (2) <u>Other indicators</u>: Strong S'ly winds along the NE coast of Libya is often a precursor of SE'ly scirocco winds over the E Mediterranean. (3) <u>SE winds at Soúda Bay have several causes which are explained in section 3.5 of the text, including</u>: (a) Lows moving S of Crete. (b) Lows moving N of Crete. (c) N African lows. If the gradient ahead of an E moving disturbance causes the winds to be from due S, the mountains to the S will partially block them. In this case, while Iráklion will be experiencing super-gradient winds due to channeling, Soúda Bay will have light S'ly winds. However, as the winds shift slightly to SW, they will increase to gradient speeds, sometimes suddenly, and they may be quite gusty. SE winds, with dust, that have their origins over N Africa near Libya are also experienced during summer. Slight changes in direction of the wind can cause large changes of wind near the entrance to Soúda Bay. If the wind is calm in the bay, but SE outside of the bay, wind speed may suddenly increase if the direction changes slightly.
strong winds and seas the protection of lar (meltemi) winds flow- not reach the outer an- 'ly swell from the Aegean ear calm conditions with main, inner portion of ong W winds which may the anchorage and berth- naval base and fuel pier. ons outside the confines be feasible until winds must sometimes wait for berthing in the bay.	b.5-7. <u>W-NW'ly winds</u>. Etesian winds, also called meltemi, dominate the E Mediterranean during summer and are the most common winds of significant velocity during summer at Soúda Bay. Defined as N'ly winds prevailing during summer in the Aegean Sea and the E Mediterranean, the etesian winds that affect Crete are a SE extension of the N wind regime over the Aegean Sea. N'ly winds prevail along the Greek coast during the winter also, but only those N'ly winds occurring between May and November are considered etesians. Etesians are discussed in detail in section 3.5.C of the text. At Soúda Bay, etesian winds are from the NW quadrant. The NW winds would likely reach the port area as WNW'ly due to the higher terrain N and S of the bay, and the valley to the W. Occasional W'ly gale may occur during the summer.

Table 3-1. (Continued)

VESSEL LOCATION/ SITUATION AFFECTED	POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVA
5. Anchored - outer bay. 6. Arriving/ departing. 7. Small boats. Winter, early Spring & late Autumn	c.5-7. N'ly winds/waves. Strong N'ly winds with associated swell/waves reach the outer anchorage during late autumn, winter and early spring.	5.c. Wind and waves reach the ou may cause anchor dragging. The c from northerly conditions can be Bay in the lee of Akrotiri Penins 6.c. Vessels inbound and outboun will be exposed to the full effec conditions when north and east of Cretan Sea. Vessels inbound to S experience no problem anchoring i those intending to anchor east of should be aware of the possibilit ging. If possible, vessels shoul Bay in the lee of Akrotiri Penins 7.c. Wind and waves may preclude ations to and from the outer anch

Table 3-1. (Continued)

'EOTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OT ABOUT POTENTIAL HAZ/
a N'ly winds/waves. esN'ly winds with associat- ndl/waves reach the outer . ıge during late autumn, and early spring. f of uc a he ou f nc . al ge	5.c. Wind and waves reach the outer anchorage and may cause anchor dragging. The closest relief from northerly conditions can be found in Soúda Bay in the lee of Akrotiri Peninsula. 6.c. Vessels inbound and outbound of Souda Bay will be exposed to the full effects of northerly conditions when north and east of Souda Bay in the Cretan Sea. Vessels inbound to Souda Bay should experience no problem anchoring in the bay, but those intending to anchor east of Ssouda Bay should be aware of the possibility of anchor dragging. If possible, vessels should anchor in Souda Bay in the lee of Akrotiri Peninsula. 7.c. Wind and waves may preclude small boat operations to and from the outer anchorage.	c.5-7. N'ly winds. (1) Local indicator. An indic approaching from N is a cloud ov Paúpa, S of the bay. (2) Causes. Wintertime N wir lished in the Aegean by the E pa low pressure system, with associ over central or S Greece. The w NW with frontal passage. This p without cyclogenesis occurring S the pattern is likely to be strc persistent with cyclogenesis occ

ɔntinued)

ɪNARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
ɜach the outer anchorage and ɩng. The closest relief ɔns can be found in Soúda ːiri Peninsula. ɩnd outbound of Souda Bay full effects of northerly ɩnd east of Souda Bay in the ɩbound to Souda Bay should ɩnchoring in the bay, but ɩor east of Ssouda Bay possibility of anchor drag- ɜsels should anchor in Souda ːiri Peninsula. ɩy preclude small boat oper- outer anchorage.	c.5-7. <u>N'ly winds</u>. (1) <u>Local indicator</u>. An indicator of a storm approaching from N is a cloud over Mt. Zoúrva Paúpa, S of the bay. (2) <u>Causes</u>. Wintertime N winds may be established in the Aegean by the E passage of a surface low pressure system, with associated cold front, over central or S Greece. The winds veer to N or NW with frontal passage. This pattern can develop without cyclogenesis occurring S of Turkey, but the pattern is likely to be stronger and more persistent with cyclogenesis occurring.

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PORT VISIT INFORMATION

MAY 1990: NOARL Meteorologists R. Fett and R. Miller met with Port Officer and Pilot, Capt. A. Bayada to obtain much of the information included in this port evaluation.

APPENDIX A

General Purpose Oceanographic Information

This section provides some general definitions regarding waves and is extracted from H.O. Pub. No. 603, Practical Methods for Observing and Forecasting Ocean Waves (Pierson, Neumann, and James, 1955).

Definitions

Waves that are being generated by local winds are called "SEA". WAVES that have traveled out of the generating area are known as "SWELL". Seas are chaotic in period, height and direction while swell approaches a simple sine wave pattern as its distance from the generating area increases. An in-between state exists for a few hundred miles outside the generating area and is a condition that reflects parts of both of the above definitions. In the Mediterranean area, because its fetches and open sea expanses are limited, SEA or IN-BETWEEN conditions will prevail. The "SIGNIFICANT WAVE HEIGHT" is defined as the average value of the heights of the one-third highest waves. PERIOD and WAVE LENGTH refer to the time between passage of, and distances between, two successive crests on the sea surface. The FREQUENCY is the reciprocal of the period ($f = 1/T$); therefore as the period increases the frequency decreases. Waves result from the transfer of energy from the wind to the sea surface. The area over which the wind blows is known as the FETCH, and the length of time that the wind has blown is the DURATION. The characteristics of waves (height, length, and period) depend on the duration, fetch, and velocity of the wind. There is a continuous generation of small short waves from the time the wind starts until it stops. With continual transfer of energy from the wind to the sea surface the waves grow with the older waves leading the growth and spreading the energy over a greater range of frequencies. Throughout the growth cycle a SPECTRUM of ocean waves is being developed.

A Beaufort Scale table with related wave effects is shown on the following page.

BEAUFORT SCALE

Beaufort Number	Wind Speed Knots	Wind Speed MPH	Seaman's term	Effects observed at sea	Term and height of Waves in meters
0	Under 1	Under 1	Calm	Sea like mirror.	Calm, glassy, 0
1	1-3	1-3	Light air	Ripples with appearance of scales; no foam crests.	
2	4-6	4-7	Light breeze	Small wavelets; crests of glassy appearance, not breaking	Rippled, less than 0.5
3	7-10	8-12	Gentle breeze	Large wavelets; crests begin to break; scattered whitecaps.	Smooth, 0.5
4	11-16	13-18	Moderate breeze	Small waves, becoming longer; numerous whitecaps.	Slight, 1.0
5	17-21	19-24	Fresh breeze	Moderate waves, taking longer form; many whitecaps; some spray.	Moderate, 1.0-2.5
6	22-27	25-31	Strong breeze	Larger waves forming; whitecaps everywhere; more spray.	Rough, 2.5-4.0
7	28-33	32-38	Moderate gale	Sea heaps up; white foam from breaking waves begins to be blown up in streaks.	Very rough, 4.0-6.0
8	34-40	39-46	Fresh gale	Moderate high waves; edges of crests begin to break; foam is blown in steaks.	
9	41-47	47-54	Strong gale	High waves; sea begins to roll; dense streaks of foam; spray may reduce visibility.	
10	48-55	55-63	Whole gale	Very high waves with overhanging crests; sea takes white appearance as foam is blown in very dense streaks; rolling is heavy and visibility reduced.	High, 6.0-9.0
11	56-63	64-72	Storm	Exceptionally high waves; sea covered with white foam patches; visibility still more reduced.	Very high, 9.0-13.5
12	64-71	73-82	Hurricane	Air filled with foam; sea completely white with driving spray; visibility greatly reduced. Winds of force 12 and above very rarely experienced on land; usually accompanied by widespread damage.	Phenomenal, greater than 13.5
13	72-80	83-92			
14	81-89	93-103			
15	90-99	104-114			
16	100-108	115-125			
17	109-118	126-136			

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21A1	CINCLANTFLT
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24A1	Naval Air Force Commander LANT
24D1	Surface Force Commander LANT
24E	Mine Warfare Command
24G1	Submarine Force Commander LANT
26QQ1	Special Warfare Group LANT
28A1	Carrier Group LANT (2)
28B1	Cruiser-Destroyer Group LANT (2)
28D1	Destroyer Squadron LANT (2)
28J1	Service Group and Squadron LANT (2)
28K1	Submarine Group and Squadron LANT
28L1	Amphibious Squadron LANT (2)
29A1	Guided Missile Cruiser LANT
29B1	Aircraft Carrier LANT
29D1	Destroyer LANT (DO 931/945 Class)
29E1	Destroyer LANT (DO 963 Class)
29F1	Guided Missile Destroyer LANT
29G1	Guided Missile Frigate (LANT)
29I1	Frigate LANT (FF 1098)
29J1	Frigate LANT (FF 1040/1051 Class)
29K1	Frigate LANT (FF 1052/1077 Class)
29L1	Frigate LANT (FF 1078/1097 Class)
29N1	Submarine LANT #SSN)
29Q	Submarine LANT SSBN
29R1	Battleship Lant (2)
29AA1	Guided Missile Frigate LANT (FFG 7)
29BB1	Guided Missile Destroyer (DDG 993)
31A1	Amphibious Command Ship LANT (2)
31B1	Amphibious Cargo Ship LANT
31G1	Amphibious Transport Ship LANT
31H1	Amphibious Assault Ship LANT (2)
31I1	Dock Landing Ship LANT
31J1	Dock Landing Ship LANT
31M1	Tank Landing Ship LANT
32A1	Destroyer Tender LANT
32C1	Ammunition Ship LANT
32G1	Combat Store Ship LANT
32H1	Fast Combat Support Ship LANT
32N1	Oiler LANT
32Q1	Replenishment Oiler LANT
32S1	Repair Ship LANT
32X1	Salvage Ship LANT

32DD1	Submarine Tender LANT
32EE1	Submarine Rescue Ship LANT
32KK	Miscellaneous Command Ship
32QQ1	Salvage and Rescue Ship LANT
32TT	Auxiliary Aircraft Landing Training Ship
42N1	Air Anti-Submarine Squadron VS LANT
42P1	Patrol Wing and Squadron LANT
42BB1	Helicopter Anti-Submarine Squadron HS LANT
42CC1	Helicopter Anti-Submarine Squadron Light HSL LANT
C40	Monterey, Naples, Sigonella and Souda Bay only
FD2	Oceanographic Office - NAVOCEANO
FD3	Fleet Numerical Oceanography Center - FLENUMOCEANCEN
FD4	Oceanography Center - NAVEASTOCEANCEN
FD5	Oceanography Command Center - COMNAVOCEANCOM (Rota)

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29B2	Aircraft Carrier PAC (2)
29R2	Battleships PAC (2)
31A2	Amphibious Command Ship PAC (2)
31H2	Amphibious Assault Ship PAC (2)
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This handbook for the port of Souda Bay, one in a series of severe weather guides for Mediterranean ports, provides decision-making guidance for ship captains whose vessels are threatened by actual or forecast strong winds, high seas, restricted visibility or thunderstorms in the port vicinity. Causes and effects of such hazardous conditions are discussed. Precautionary or evasive actions are suggested for various vessel situations. The handbook is organized in four sections for ready reference: general guidance on handbook content and use; a quick-look captain's summary; a more detailed review of general information on environmental conditions; and an appendix that provides oceanographic information.

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